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HERBICIDE TRIALS IN INTENSIVELY CULTURED *POPULUS* PLANTATIONS IN NORTHERN WISCONSIN

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ABSTRACT.—*Populus* had good survival and growth when planting sites had been treated with linuron, a pre-emergent herbicide, alone or in combination with paraquat, a post-emergent herbicide. The herbicide treatments that are most effective in intensive culture are discussed.

OXFORD: 441—414.1:238:236.1. KEY WORDS: Competition, pre-emergent, post-emergent, hardwood cuttings, weeds.

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

Using intensive plantation culture to increase yields is one way to help meet the rising demand for wood products. Many practices have already been found to increase yield of intensive culture plots—use of genetically improved stock, fertilization, irrigation—but further investigations may discover even more ways to increase biomass production. Although the use of herbicides to control weeds and thereby increase production has already been proven (Erdmann 1967, Erdmann and Green 1967, von Althen 1970), the toxic effect of specific chemicals and the proper application rates are not known for *Populus*.

Cram (1967) recommended local testing of herbicide treatments and other adaptation for the specific sites that may be used in intensive culture. Information should be developed locally on the different levels of treatment intensity by using both a post-emergent in combination with a pre-emergent herbicide and by varying the application rates.

We conducted a study to evaluate the effects of 12 herbicide treatments on competing vegetation and growth of *Populus 'Tristis #1'* (*Populus balsamifera L. x P. tristis* Frisch.) cuttings. The locations represent sites where intensive culture plantations may be established in future studies. These included a clearcut forested site, an abandoned farm field with established sod, and a well-cultivated field.

PROCEDURES

Sodded and clean-tilled sites were located on the Hugo Sauer Nursery in Rhinelander, Wisconsin, and the clearcut site was located on the Harshaw Experimental Farm approximately 10 miles west of Rhinelander. Three pre-emergent herbicides were tested—simazine (Princep),[1] linuron (Lorox), and dichlobenil (casoron)—as well as two post-emergent herbicides—paraquat (Ortho Paraquat) and glyphosate (Roundup). Dichlobenil was applied in granular form and raked into the soil surface. Simazine and linuron were mixed in a 2-gallon sprayer in the amounts required to cover one plot. Glyphosate and paraquat were applied in a tank mix with the pre-emergents in the first year and direct sprayed in the second year. Pre-emergent herbicides were applied prior to planting. Post-emergent herbicides were applied in combination with the pre-emergents the first season and alone the second season. The codes that will be used in the rest of the publication for the 12 herbicide treatments are shown in table 1.

Each herbicide treatment was replicated 3 times on each of the 3 sites in a randomized block design. Thirty-six 4- by 4-foot plots with a 4-foot buffer strip were established a' each site (on a 44- by 44-foot area) and 16 trees were planted on each plot at 1- by 1- foot spacing. Before planting the nursery site was rototilled, the sod site was disked and rototilled, and the clearcut site was prepared by clearing all woody vegetation and clipping volunteer sprouts. The herbicides were first applied on June 28, 1974.

Populus cuttings (6 to 8 inches long and 3/8-to 5/8-inch diameter) from the previous year's growth were collected in April 1974 and stored in a freezer until they were planted on July 1 to 3, 1974. Cuttings planted on the nursery and sod sites were unrooted, but cuttings planted on the aspen site were prerooted in styrofoam blocks using a 1-1-1 media of soil-sand-peat because they could not be watered after planting. The nursery site was irrigated continually as needed throughout the growing season and the sod site was hand watered for 2 weeks. Cuttings on the clearcut site received a cup of water at planting.

Height, diameter (1 inch above the ground), and survival were determined at the end of the growing seasons in 1974, 1975, and 1976. Before the first frost in 1974 and 1975, weeds from each plot were clipped, separated by genus, ovendried, and weighed. Two-way analysis of variance, regression analysis, and Duncan's new multiple range test (Li 1964) were run at the 5 percent significance level.

RESULTS

Analysis of variance showed that there were significant treatment effects on survival on the nursery site in 1975, the sodded site in 1975 and 1976, and the clearcut site in 1975, and on height on the sodded site in 1976. Correlations of *Populus*

[1] *Mention of trade names does not constitute endorsement of the products by the USDA Forest Service.*

Table 1.—*Treatment codes for herbicide combinations, application rates*[1]*, and sequences*

Treatment code	First year		Second year
	Pre-emergent and rate[1]	Post-emergent and rate	Post-emergent and rate
L4	4 lb. Linuron	--	--
L4, P½	4 lb. Linuron	½ lb. Paraquat	--
L4, P½, 2	4 lb. Linuron	½ lb. Paraquat	½ lb. Paraquat
L4, G3, 2	4 lb. Linuron	3 lb. Glyphosate	3 lb. Glyphosate
L8	8 lb. Linuron	--	--
D150	150 lb. Dichlobenil	--	--
D150, P½,2	150 lb. Dichlobenil	--	½ lb. Paraquat
S2	2 lb. Simazine	--	--
S4, P½,2	4 lb. Simazine	½ lb. Paraquat	½ lb. Paraquat
S4, G3, 2	4 lb. Simazine	3 lb. Glyphosate	3 lb. Glyphosate
S6	6 lb. Simazine	--	--
Control	--	--	--

[1] Application rates refer to total rather than active ingredient of the herbicide.

height and survival with weights of the competing vegetation by species were nonsignificant.

Three treatments involving moderate application rates of linuron alone and in combination with paraquat or glyphosate showed promise for eventually improving biomass production. Cuttings raised under the treatment of 4 lb. acre of linuron alone (L4) or in combination with ½ lb. of paraquat applied in the first year (L4,P½,1) or first and second year (L4,P½,2) generally had superior survival. Survival in 1976 for these treatments was 33, 40, and 38 percent, respectively, on the sodded site (table 2). Treatment (L4) resulted in 90 percent survival in 1976 on the nursery site compared to 81 percent for treatment (L4,P½,1) and 71 percent for treatment (L4, P½,2). In 1976, survival on the clearcut site was 31 percent for treatment (L4) contrasted to 31 percent (L4,P½,1) and 42 percent for treatment (L4,P½,2). Treatments (L8), (S2), and (L4,G3,2) also resulted in good survival of the cuttings.

Low dosages of linuron and simazine gave better results than high dosages, possibly because of a toxic affect. Surprisingly, survival was highest on the nursery control plots in both years. This may indicate either a herbicide toxic effect or no real competition from the small amount of vegetation present on this site.

Table 2.—*Effect of herbicide treatment on mean survival of* Populus *cuttings planted on three northern Wisconsin sites*

(In percent)

Treatment code[1]	Site					
	Nursery		Sod		Clearcut	
	1975	1976	1975	1976	1975	1976
L4	[2]85[ab]	[3]85	50[b]	33[ab]	54[a]	[3]31
L8	88[a]	67	52[b]	25[bc]	42[abc]	31
D150	65[bc]	65	4[c]	2[c]	10[c]	6
S2	77[abc]	56	29[c]	8[c]	63[a]	44
S6	38[c]	35	8[c]	2[c]	17[c]	8
L4,P½,1	81[abc]	81	69[a]	40[a]	56[a]	31
L4,P½,2	73[abc]	71	48[bc]	38[ab]	48[ab]	42
S4,P½,2	54[bc]	54	17[c]	13[c]	35[bc]	19
D150,P½,2	46[c]	44	4[c]	0[c]	8[c]	2
L4,G3,2	75[abc]	75	29[c]	19[c]	42[abc]	19
S4,G3,2	48[c]	48	4[c]	4[c]	33[bc]	15
Control	94[a]	94	10[c]	0[c]	48[ab]	33

[1]See table 1 for explanation of treatment description codes.

[2]Letters following the means indicate differences that are significant at the 95 percent probability level.

[3]No significant differences at 0.05 level of confidence.

Treatments (L4), and (L4,P½,1) resulted in superior height growth (table 3). Treatment (S4,P½,2) also gave good results as did treatments (L4,P½,2) and (L4,G3,2). Height growth was 43 cm in treatments (L4), (L8), and (L4,P½,1) on the sodded site and was 40 cm in treatment (S4,P½,2). On the clearcut site treatment (L4), (S2), (L4,P½,1), and (L4,P½,2) gave good height results—41 cm, 53 cm, 50 cm, and 41 cm, respectively. On the nursery site the treatments (L4), (L8), (S2), and (L4,P½,2) resulted in heights of 233 cm, 224 cm, 240 cm, and 246 cm, respectively.

The weed species present on the control plots of the three sites in 1974 are shown below.

The weed species present on the control plots of the three sites in 1974 are shown below.

Genus	Common Name	Weight (Pounds/acre)
	—NURSERY—	
Spergula	Sand spurry	257
Portulaca	Purslane	323
Mollugo	Carpetweed	158
Other		38
Total		776
	—SOD—	
Agropyron	Quackgrass	1,008
Polygonum	Bindweed	335
Chenopodium	Lambsquarter	301
Lychnis	Cockle	187
Taraxacum	Dandelion	97
Other		86
Total		2,014
	—CLEARCUT—	
Prunus	Cherry	889
Corylus	Hazel	369
Pteridium	Bracken fern	345
Populus	Aspen	324
Waldsteinia	Barren strawberry	198
Rubus	Blackberry	160
Aster	Large leaf aster	102
Other		162
Total		2,549

Neither seedling height nor survival was significantly correlated with the weights of competing plants.

Table 3.—*Effect of herbicide treatment on mean height of* Populus *in 1976 on three sites in northern Wisconsin*

(In cm)

Treatment code[1]	Site: Nursery	Sod	Clearcut
L4	[2]233	[3]43[a]	[2]41
L8	224	43[a]	29
D150	182	8[c]	17
S2	240	9[bc]	53
S6	220	6[c]	12
L4,P½,1	222	43[a]	50
L4,P½,2	246	36[ab]	41
S4,P½,2	189	40[a]	30
D150,P½,2	204	0[c]	15
L4,G3,2	202	33[abc]	33
S4,G3,2	188	16[bc]	30
Control	212	0[c]	38

[1]See table 1 for explanation of treatment description codes.

[2]No significant differences at the 0.05 level of confidence.

[3]Letters following the means indicate differences that are significant at the 95 percent probability level.

DISCUSSION

Compared to the control, herbicide treatments improved survival and growth on the sodded site, had no effect on the clearcut area, and possibly had an adverse effect in the nursery. Apparently the thorough tilling on the nursery site eliminated the need for weed control after planting. Linuron at 4 lb/acre on the sodded site increased survival, as did the additional use of paraquat through this contribution is small. Simazine increased survival on the clearcut site. Treatments (L4), (L4,P½,1), (L8), (L4,P½,2), and (L4,G3,2) showed consistently good results. For the most part these are combinations of linuron with a post-emergent herbicide. The use of simazine with the post-emergent glyphosate also increased survival and height growth.

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